

## REMARKS

The claims are now 22-29.

The previous claims were rejected under 35 USC 103(a) over Kongshaug et al. (U.S. 4,973,457) (cited in applicants' IDS) in view of Fetzer et al. (U.S. 5,587,135). Applicants respectfully disagree with the examiner's analysis vis-à-vis § 103(a).

The present invention relates to a process and a reactor for the catalytic oxidation of ammonia to nitrogen oxides. The reactor contains a noble metal gauze catalyst and a heat exchanger in that order in the direction of flow and has a catalyst for the decomposition of  $N_2O$  located between the noble metal gauze catalyst and the heat exchanger. According to the present invention the residence time over this catalyst for the decomposition of  $N_2O$  is very short, i.e. less than 0.05 s, compare example 2 on page 8, specifically lines 12 to 13 of the specification in combination with page 4, line 3 and page 6, lines 19 to 22 of the specification.

This short residence time is achieved by installing the catalyst for the decomposition of  $N_2O$  as a fixed bed having a height of from 5 to 10 cm, compare page 6, lines 19 to 22 of the specification.

Consequently, the claims now contain the feature that the residence time over the catalyst for the decomposition of  $N_2O$  is less than 0.05 s, and the apparatus claim directed to the reactor contains the feature that the catalyst for the decomposition of  $N_2O$  is installed as a fixed bed having a height of from 5 to 10 cm.

According to the present invention, it has been found that  $N_2O$  can be decomposed directly in the reactor for the catalytic oxidation of ammonia when a

suitable catalyst is located between the noble metal gauze catalyst and the heat exchanger. In this way, the  $N_2O$  formed as by-product is decomposed immediately after it is formed. The catalyst for the decomposition of  $N_2O$  which is used according to the present invention is located directly in the reactor, preferably between the position of a noble metal recovery gauze located downstream of the noble metal catalyst in the position of the heat exchanger. Existing reactors can easily be modified by additionally providing a holder for the  $N_2O$  decomposition catalyst, see page 3, lines 19 to 31 of the specification.

The low catalyst bed height required according to the present invention allows for installation in existing reactors without great rebuilding of the reactors. Thus, existing reactors can be modified to enable the process of the present invention to be carried out, without replacement of the reactor being necessary, see page 3, lines 33 to 36.

The pressure drop caused by installation of the catalyst is very low due to the low height of the catalyst bed and the short residence time. A small amount of catalyst can be employed, and the gas has to be held at a high temperature level for only a short time after the oxidation, so that secondary reactions can largely be suppressed, see page 4, lines 3 to 6.

As it is evident from the examples, very short residence times over the  $N_2O$  decomposition catalyst can be employed. According to example 2 the residence time is less than 0.05 s, whereas according to example 1 the residence time is 0.03 s.

On page 6, lines 27 to 31 it is again pointed out that as a result of the low height of the catalyst bed only a small pressure drop occurs in the reactor. No additional

SCHUMACHER et al., Ser. No. 09/647,047

heating or cooling is required for the removal of  $N_2O$ . A rebuilding of a nitric acid plant is generally not necessary.

The Kongshaug reference (U.S. 4,973,457) has already been discussed. The invention underlying the Kongshaug reference is to allow for a retention time of 0.1 to 3 seconds before ammonia combustion gases are cooled in a heat recovery unit in the Ostwald-process, see claim 1, columns 5 and 6.

In the specification and claims it is pointed out that the retention time of 0.1 to 3 seconds is essential for the claimed process. According to claim 2 the retention time is 0.5 to 2 seconds.

Usually, the reactor for the catalytic combustion of ammonia has to be changed in order to provide the necessary space for this residence time before the heat recovery unit. In column 3, lines 10 to 13 it is stated that in order to reduce the retention time for desired decomposition of  $N_2O$ , a metal or metal oxide catalyst which selectively decomposes  $N_2O$  after the catalyst package can be installed. However, it is not stated that the retention time of 0.1 to 3 seconds will be further reduced. In the examples, retention times of 1 or 2 seconds were employed, see table 2 in column 4. Thus, the person skilled in the art reading the Kongshaug reference would assume that a retention time in the order of seconds will be desirable to achieve the decomposition of  $N_2O$ . Shorter retention times, i.e. at the lower end of the range taught by Kongshaug, could be achieved by employing the catalyst for selectively decomposing  $N_2O$ . However, the person skilled in the art would not learn from Kongshaug that by employing a catalyst for the decomposition of  $N_2O$  a residence time over the catalyst

SCHUMACHER et al., Ser. No. 09/647,047

could be reduced to less than 0.05 seconds. The Kongshaug reference contains no pointer in the direction of employing these very short residence times over the catalyst for the decomposition of  $N_2O$ . According to the present invention, it was found that a fixed bed having a height of from 5 to 10 cm of the catalyst for the decomposition of  $N_2O$  and a residence time over the catalyst for the decomposition of  $N_2O$  of less than 0.05 seconds, respectively, is sufficient for removing  $N_2O$ . This finding could by no way be derived from the Kongshaug reference. The Kongshaug reference contains no pointer in the direction of the height of the catalyst bed and the very short residence time over the catalyst bed. On the contrary, the main issue of Kongshaug is to work with residence times in the range of seconds and not 0.05 seconds or less.

U.S. 5,587,135 (Fetzer) relates to a process for the catalytic decomposition of denitrogen monoxide in a gas stream. This reference discusses a specific catalyst for the decomposition of  $N_2O$  which is also preferably employed according to the present invention. However, this reference does not deal with including a catalyst for the decomposition of  $N_2O$  directly in a reactor for the catalytic oxidation of ammonia to nitrogen oxides. In the specification, a detailed reference is only made to off-gases from adipic acid plants, see column 1, line 50. Furthermore, the Fetzer reference does not contain any pointer in the direction of low heights of the fixed bed catalyst and very short residence times. The Fetzer reference as well as the Kongshaug reference are totally silent as to implementing the catalyst for the decomposition of  $N_2O$  in existing reactors without rebuilding or reconstruction of the reactor. This is the specific finding of the present invention, i.e. that a fixed bed of a  $N_2O$  decomposition catalyst of a low

SCHUMACHER et al., Ser. No. 09/647,047

height can be installed in all typical Ostwald reactors and at the same time achieving very high degrees of  $N_2O$  decomposition.

The thrust of the examiner's position is that "it would have been obvious...to have determined by experimentation the height of the catalyst in [applicants'] catalyst" and would have involved but "a mere change in the size of a component." In support of his position the examiner cites *In re Rose*, 220 F.2d 459, 105 USPQ 237 (CCPA 1955) and *In Gardner v. TEC Systems, Inc.*, 725 F.2d 1338, 220 USPQ 777 (Fed.Cir. 1984), cert. denied, 469 U.S. 830, 225 USPQ 232 (1984). However, as discussed above, applicants' invention involves more than just a "mere" change of size; it provides, *inter alia*, for "the residence time over the catalyst for the decomposition of  $N_2O$  of less than 0.05 s." This result is nowhere suggested or expected from the prior art. Both *Rose* and *Gardner* are clearly distinguishable on their facts.

The references do not make out the necessary prima facie case for obviousness. The examiner presents, in essence, an "obvious to experiment" (or "obvious to try") standard which is not a standard for obviousness. See, *inter alia*, *In re Dow Chemical Co.*, 837 F.2d 469, 5 USPQ2d 1529, 1532 (Fed. Cir. 1988). As explained in *Dow*, 5 USPQ2d at 1532 regarding such a standard,

...selective hindsight is no more applicable to the design of experiments than it is the combination of prior art teachings. There must be a reason or suggestion in the art for selecting the procedure used, other than the knowledge learned from the applicant's disclosure. [citation omitted] Of the many scientific publications cited by both *Dow* and the PTO, none suggested that any process could be used successfully in this three-component system, to produce this product having the desired properties.

Lacking from the prior art cited is the necessary teaching or suggestion or motivation to

SCHUMACHER et al., Ser. No. 09/647,047

combine the references in such a way as to come up with applicants' invention.


Moreover, the examiner is respectfully requested to keep in mind that claims 22-24 are directed to the apparatus while claims 26-29 are directed to the process. Being different statutory classes, they should be treated as different inventions. See *Studiengesellschaft Kohle mbH v. Northern Petrochemical Company*, 228 USPQ 837 (Fed.Cir. 1986).

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Accordingly, allowance is respectfully solicited.

Respectfully submitted,

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